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Considerations for implementing models for optimizing the volume and efficiency of male circumcision services

MOVE

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Contents

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Abbreviations

ANRS	Agence nationale de recherches sur le sida et les hepatites virales
COBAN	cohesive bandage
DHS	demographic and health survey
EtO	ethylene oxide
HIV	human immunodeficiency virus
HQHV	high-quality, high-volume
IV	intravenous
MC	male circumcision
MOVE	models for optimizing volume and efficiency (of services)
NGO	nongovernmental organization
OT	operating theatre
PSI	Population Services International
STI	sexually transmitted infection
UNAIDS	Joint United Nations Programme on HIV/AIDS
WHO	World Health Organization

Background

In the light of the conclusive evidence that male circumcision provides partial protection against HIV acquisition by men, WHO/UNAIDS recommended that male circumcision be considered as an additional HIV prevention intervention and added to existing comprehensive HIV prevention packages in countries with predominantly heterosexual epidemics.[1]

Mathematical models that have been developed to estimate the potential impact at the population level of male circumcision on HIV incidence in high-prevalence settings have produced similar findings.[2] The models indicate large benefits of circumcision among heterosexual men in settings of low male circumcision and high HIV prevalence, with one HIV infection averted for every 5 to 15 male circumcisions performed. The public health impact could be enhanced, depending on the scale and pace of service delivery, sexual risk compensation and the uptake of complimentary prevention, care and treatment services.

All the models show that rapid expansion of male circumcision coverage will result in earlier and larger effects on HIV incidence. An expert review group concluded that rapid initial scale-up produces direct and indirect effects earlier and is considerably more cost-effective, with fewer circumcisions required to avert one infection and more infections averted at a lower cost per infection averted over time.[2] Although modelling suggests that male circumcision alone cannot completely stop the epidemic, substantial gains are likely to be achieved when male circumcision is scaled up in combination with other prevention strategies.[2] The greatest impact could be achieved when circumcision is scaled up together with an intensified focus on reducing sexual risk behaviour.[3]

Male circumcision is a minor surgical procedure that can be provided in aseptic settings by well-trained competent health professionals using proper equipment and supplies. However, to maximize the impact of male circumcision on the HIV epidemic, WHO recommends that the surgery should not be provided alone but as part of a minimum package of services (Box 1). Therefore male circumcision for HIV prevention service delivery does not focus only scaling up a surgical intervention but also includes a number of complimentary counselling and clinical service components.

Box 1. Minimum package for male circumcision services recommended by WHO

- HIV testing and counselling
- Active exclusion of symptomatic sexually transmitted infections (STIs); syndromic treatment where required
- Provision and promotion of male and female condoms
- Counselling on risk reduction and safer sex
- Male circumcision surgical procedures performed as described in the *Manual for male circumcision under local anaesthesia*

Based on calculations using DHS data as many as 38 million adolescent and adult males in Africa could benefit from male circumcision for HIV prevention services. For example, the Kenya Voluntary Medical Male Circumcision Strategic Plan estimates that it will be necessary to perform 150 000 male circumcisions per year over the next five years to meet the target of increasing male circumcision prevalence from 84% to 94% by 2013.

The scale-up of male circumcision will require a vast pool of trained and competent health personnel to achieve the requisite scale and pace of service delivery. It is therefore necessary to rationalize and maximize the use and time of such personnel. Conventional surgical models where one doctor works with one assistant per client only allow an individual surgeon to do an average of 8–10 male circumcisions per day. At this pace, performing the high numbers of male circumcisions required to make an impact on the epidemic and achieving rapid scale-up is highly improbable. In order to reach a large number of boys and men with comprehensive male circumcision services, careful orchestration of skills, commodities and infrastructure will be required.

Finding ways to improve the efficiency of service delivery and the use of personnel time is critical, as many countries are faced with shortages of health-care providers and other resources. Improving efficiency in male circumcision service delivery could also contribute to the strengthening of health systems by making more resources available to meet other needs of health-care services.

Purpose

The purpose of this document is to outline various considerations and options for organizing adult medical male circumcision surgical services so as to improve the efficiency* and service volume** while assuring a safe service of high quality. The chapters of the document outline the following key areas.

1. Clinical considerations
2. Staff considerations for optimizing efficiency
3. Optimizing the use of facility space
4. Client considerations
5. Supply chain management
6. Cost efficiencies
7. Quality assurance

The document provides guidance to programme managers involved in setting up or strengthening male circumcision services. This guidance is relevant to such services in both the private and public sectors. The information provided is also useful for funders and policy-makers who need to make decisions about the costing and financing of male circumcision services.

The document does not recommend a single efficiency model that is appropriate for all countries, programmes or facilities but proposes options for consideration, depending on country circumstances and the local context. For any given country, different facilities could adopt various aspects of the efficiency models. Efficiencies can be gained in 'high or low volume' settings. Factors such as the scope of practice of different cadres of heath professionals, the reliability of electricity, the availability of health-care facilities, levels of demand, and political considerations will influence the efficiency options adopted.

Although all components of the *Minimum package of male circumcision services* are equally important, the focus of this document is on improving the efficiencies of the clinical surgical component of the services.

* The per-client time required to deliver safe services of high quality.

** The number of clients provided with male circumcision services.

1. Clinical considerations

The clinical considerations for MOVE are in line with the WHO/UNAIDS/Jhpiego *Manual for male circumcision under local anaesthesia*.

1.1 Surgical techniques

The three recommended methods of male circumcision, viz. the forceps-guided, dorsal slit and sleeve resection methods, are described in the WHO/UNAIDS/Jhpiego *Manual for male circumcision under local anaesthesia*. These methods have comparable cosmetic outcomes, and none has demonstrated superior efficiency in preventing HIV infection.

A model for optimizing the volume and efficiency (MOVE) of male circumcision services could be devised using any of the three surgical methods by carefully examining the requirements for all the surgical steps, as well as conscientious use of staff skills, staff time, facility layout or design, and efficient client scheduling and flow through the facility.

1.2 Haemostasis by diathermy

The use of diathermy for haemostasis is a key aspect of rationing staff time and improving the efficiency of male circumcision surgery. Diathermy involves using an electric current to coagulate the ends of blood vessels so as to stop bleeding. It has the advantage of decreasing haemostasis time during surgery, thereby shortening the procedure time. Used by a well-trained surgeon it is a useful, safe and time-saving tool.

1.2.1 *Monopolar and bipolar diathermy circuits*

Two diathermy electrical circuits are in common use: monopolar and bipolar. With monopolar diathermy the current runs from the machine through a diathermy forceps, through the tissue held by the forceps, through the patient's body to a grounding plate placed elsewhere on the body, and then back to the machine. In bipolar diathermy the current runs from the machine to one of the two prongs of a diathermy forceps, through the tissue grasped between the two prongs of the forceps and then back from the other prong to the machine.

Whichever system is in use, the surgeon needs to understand the principles of the electrical circuit. Care has to be taken to ensure that the patient is not in contact with any metal or conducting material, otherwise there is a risk of an electrical current to earth and burns at the point of contact with the conducting material. This risk is greatest with monopolar diathermy but, whenever diathermy is used, care must be taken in the positioning on the operating table, the choice of operating tables and clinic construction to prevent leakage of current to earth.

More sophisticated monopolar diathermy machines have safety features incorporated in their design, including automatic switch-off if there is a fault in any of the following: detection of earth leakage; detection circuit to verify that the grounding plate is connected; detection circuit to verify that the grounding plate is making sufficient contact with the skin. If, when the surgeon activates

the current, the machine fails to respond or if there is no obvious and immediate visual evidence of coagulation, the surgeon should immediately stop applying the current, check all the connections and check that the grounding plate has been properly applied. If the surgeon continues to apply the current in this circumstance, burns may occur where the resistance to the current is greatest. This is most likely to occur at the site of an incorrectly placed or faulty grounding plate or where the patient's body is in contact with metal; rarely, burns may occur elsewhere in the body.

The grounding plate should be placed so that there is a broad area of contact between it and the patient's skin. The thigh or buttock is commonly used for this purpose. Sometimes it is necessary to shave hairs to ensure good contact. The surgeon should be aware that many diathermy machines have settings for coagulation or cutting currents and that for haemostasis the coagulation setting should be used.

1.2.2 *Diathermy technique*

When using diathermy the surgeon should apply the forceps as precisely as possible. The best results are obtained if the blood vessel is between the diathermy tongs with minimal other tissue. Also the current should be activated for the shortest time needed to ensure haemostasis. If too much tissue is grasped, diathermy will not stop the bleeding because the burn is too diffuse. Prolonged diathermy causing large black burns should be avoided as these may result in infection, increased postoperative pain and the formation of scar tissue. Particular care has to be taken in the frenular area because the urethra is near the surface and there is a small potential risk of burning through to the urethra and creating a fistula. Diathermy should also be used with caution close to the skin and mucosal edges, as transmitted heat close to the mucosa or skin has the potential to cause skin burns. Diathermy can be used to stop bleeding from small blood vessels, but for larger vessels it is sometimes necessary to use an artery forceps and a tie or under-run.

All staff using diathermy for haemostasis should also be trained and competent in the ligation of sutures for haemostasis, even if diathermy is the main method of achieving haemostasis at the site. The ligation of sutures is an effective means of achieving haemostasis, particularly if the bleeding vessel is relatively large or if a diathermy machine or electricity is not available. An appropriate combination of diathermy and ligation of sutures is more efficient (taking less time) than the ligation of sutures alone for achieving haemostasis. As battery-powered options for diathermy devices, as well as generators, are available, the reliability of electricity should not be a barrier to utilizing diathermy.

2. Staff considerations for optimizing efficiency

2.1 Task-shifting and task-sharing

The scaling up of male circumcision requires a vast pool of trained and competent health-care providers in order to achieve the requisite scale and pace of service delivery. All the countries that need to scale up male circumcision for HIV prevention have relatively weak health systems and a critical shortage of skilled health professionals. It is therefore necessary to find ways to rationalize and maximize the use and time of trained, competent health-care personnel.

Task-shifting refers to the use of non-physician providers to complete all steps of male circumcision surgery. **Task-sharing** refers to the use of non-physician/lower cadres of health-care providers to complete specific steps of male circumcision surgery. This allows the operator (or surgeon) to focus on the most technically complex components of the surgery. In task-shifting and task-sharing models, surgical activities are reassigned, where appropriate, from those providers qualified for such interventions, e.g. physicians, to other appropriately trained and competent health-care providers, e.g. clinical officers and nurses.

The shifting or sharing of surgical tasks among health-care cadres allows more highly trained health professionals additional time to dedicate themselves to the most complex clinical tasks, thus helping to address staffing shortages and reducing the cost of the service provided.

The successful use of non-physician providers to perform more complex clinical and surgical procedures has been well documented in various countries. Appropriately trained non-physician providers can safely conduct procedures such as caesarean sections, mini-laparotomies, non-scalpel vasectomy, repair of simple obstetric fistula, and manual vacuum aspiration.[4] It has also been demonstrated that trained and competent clinical officers can successfully and safely perform male circumcision.[5] In Kenya, for example, clinical officers who routinely conducted consultations and selected surgical procedures were trained in the techniques of adult male circumcision. In order to scale up the availability of male circumcision services, therefore, WHO recommends that countries should identify non-physician providers who can be trained to perform male circumcision surgery and provide comprehensive services. [4]

Although some or all clinical tasks may be shared with non-physician cadres, the ultimate responsibility for surgical care rests with the physician in charge of supervising the procedure. All non-physician providers performing surgical tasks should be supervised by a formally designated provider. In task-sharing the 'surgeon' should be available on site until the client leaves the operating table.

Task-shifting or task-sharing can only occur as permitted by national laws and regulations. In many countries, national regulations allow for relatively easy expansion of health professionals' tasks. However, where the regulations do not allow for non-physician providers to perform certain clinical functions, efforts should be made to amend them.

Throughout this document, the 'surgeon' is the individual ultimately responsible for the appropriate execution of male medical circumcision surgery, whether he or she performs only some or all of the surgical steps.

2.1.1 *Surgical steps for task-shifting or task-sharing*

In standard male circumcision services a single well-trained health professional, a 'surgeon', performs all clinical aspects of the surgical operation. This health professional is usually a certified physician, either a highly qualified specialist surgeon or a trained general physician. The 'surgeon' is assisted by a team. Regardless of the clinical technique used, the clinical components of male circumcision surgery can be broken down to the following main steps.

1. Injection of local anaesthesia
   Note: The WHO surgical manual recommends surgical preparation before injection of local anaesthesia. However, to optimize efficiency, injection of local anaesthesia can precede surgical preparation. This allows the anaesthesia to take effect during the surgical preparation so that the surgeon may commence surgery immediately afterwards.
2. Surgical preparation (disinfection and draping of the site)
3. Marking
4. Palpation of glans
5. Placement of forceps
6. Surgical removal of the prepuce (includes dissection for sleeve resection)
7. Haemostasis
8. Placement of four mattress sutures
9. Placement of simple interrupted sutures
10. Dressing

In order to optimize service delivery the surgeon does not need to perform all of the above surgical steps. Many or all of them can be taught and delegated to less-skilled, highly focused staff. Allocation of the less complex steps to one or more health-care cadres who are not surgically qualified gives the surgeon more time for other operations.

Exactly which steps are shared, and the cadre and number of staff members they are shared with, depends on the staffing realities, national laws/regulations and individual aptitudes. Annex 1 provides a more detailed outline of how efficiencies may be optimized in each of the surgical steps.

2.2 Staff time

In areas where male circumcision surgeons are in short supply the surgeon's time is a key factor in maximizing efficiency and volume. Observation of the time required to complete each of the nine surgical steps in a few sites indicates that the overall procedure time varies with the surgical technique used. The time may also vary with the client, the provider and the setting of the service.

TABLE 1. COMPARISON OF CLINICAL COMPONENTS AND ESTIMATED AVERAGE TIMES FOR THREE SURGICAL METHODS*

Forceps-guided		Dorsal slit		Sleeve resection	
Activity	Time (min)	Activity	Time (min)	Activity	Time (min)
Injection of anaesthesia	1:00	Injection of anaesthesia	1:00	Injection of anaesthesia	1:00
Surgical preparation	3:00	Surgical preparation	3:00	Surgical preparation	3:00
Marking	0:15	Marking	0:15	Marking (2)	0:30
Palpation of glans	0:15	Forceps placement (4)	1:00	Cut (3)	3:00.
Forceps placement	0:15	Cut (2)	2:00	Dissection	5:00
Cut	0:05	Haemostasis‡	2:00	Haemostasis‡	2:00
Haemostasis‡	2:00	Mattress sutures (4)	3:30	Mattress sutures (4)	3:30
Mattress sutures (4)	3:30	Sutures – other	5:30	Sutures – other	5:30
Sutures – other	5:30	Dressing	3:30	Dressing	3:30
Dressing	3:30				
Surgeon time:	6:20	Surgeon time:	8:45	Surgeon time:	14:00
Procedure time	19:20	Procedure time	21:45	Procedure time	27:00

‡Haemostasis time is for diathermy.

* Times depicted are based on time-motion observations at Orange Farm, South Africa.

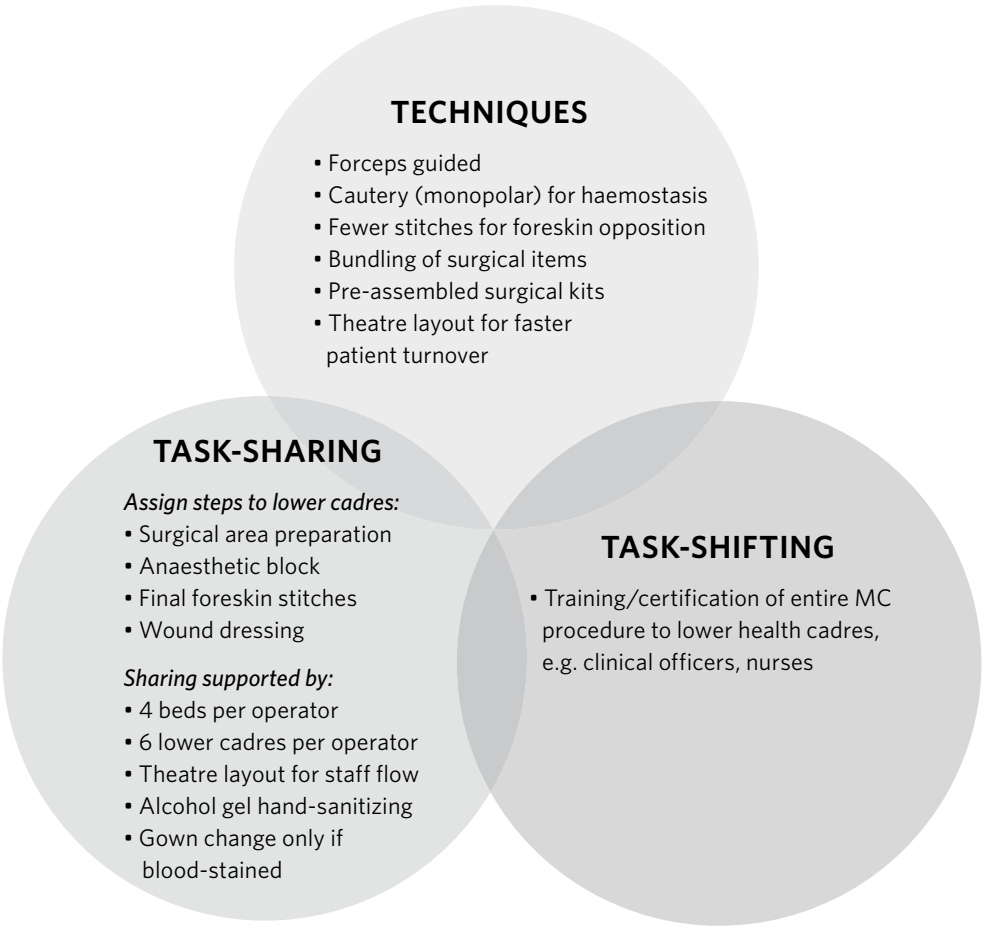
As the number and technicality of steps increases there are consequent increases in surgeon and overall procedure time. Moreover, there are increases in the amount of training required. The steps directly related to the removal of the prepuce, viz. marking, forceps placement, cutting/dissection, and placement of the mattress sutures (Table 1), are the most technically complex and should be performed by the surgeon responsible for the entire procedure. Other health-care providers can be trained in each of the different specific steps (steps 1, 2, 9 and 10) to assist the surgeon, or preferably can be cross-trained in multiple skills to ensure flexibility in scheduling and improve efficiency. The surgeon must have all the skills and competencies and hold ultimate responsibility for the provision of all services, whether he or she performs all tasks or not. The number of individual health-care personnel required to complete the surgery varies with the surgical technique used and the layout of the facility (Section 2.3).

TABLE 2. ANALYSIS OF TIME SAVINGS BETWEEN THE THREE SURGICAL METHODS (BASED ON TIME-MOTION OBSERVATIONS)

Surgical methods compared	Time savings to surgeon/procedure (minutes)
Forceps-guided/dorsal slit	2:25
Forceps-guided/sleeve resection	7:40
Dorsal slit/sleeve resection	5:15

Other important skills required to increase time efficiency include those of administrative assistants or clerks responsible for completing all relevant paperwork. Furthermore, the coordination of specialized cleaning staff skilled in infection prevention is important to the turnover time of surgical bays between client operations.

FIGURE 1. THE THREE CATEGORIES OF APPROACHES THAN CAN BE USED TO FOSTER HIGH-QUALITY, HIGH-VOLUME MALE CIRCUMCISION SERVICES*



*They can be used separately or together.

Techniques refers to specific technical options that can speed the surgical process, while maintaining high quality. For example, the forceps-guided circumcision method is quicker than the sleeve or dorsal slit methods in all but the most skilled surgeon's hands. Haemostasis using diathermy can save several minutes per procedure, as compared with the ligation of bleeders. Wrapping surgical items together (instead of individually) speeds the set-up process.

Task-shifting refers to the use of non-physician providers to complete all steps of male circumcision surgery.

Task-sharing refers to methods for assigning steps in the circumcision process to lower cadres, thereby allowing the operator (or surgeon) to focus on the most technically challenging components of circumcision (the cut, haemostasis, and anchor sutures). For example, a lower cadre can be responsible for cleaning and preparing the area around the penis. Similarly, an appropriately trained lower cadre can administer the ring block.

Importantly, these three categories of approaches can be used in combination to obtain greater efficiency and volume. The ***techniques*** can be used with ***task-sharing*** so that all cadres use the most efficient techniques, e.g. the surgeon employs cautery. Similarly, the efficient ***techniques*** can be used by a lower cadre to whom the entire procedure has been task-shifted. There is even efficiency in combining task-sharing and task-shifting, where a roving operator (to perform the cut, haemostasis, and anchor stitches) and one assistant per bed are employed to reduce the overall staff need as compared with one operator and one assistant per bed.

2.3 Staff ratios

Optimal staff ratios to maximize efficiency of staff skills for male circumcision surgery depend on the surgical method chosen and the design and layout of the facility.

The following proposed model, based on experience gained in the Bophelo Pele Project, Orange Farm, South Africa, involves one surgeon allocated to four clients in separate surgical bays and five ancillary staff. Other principles for efficiency are also based on experience of high-quality, high-volume cataract surgery provision at the Aravind Eye Hospital in India. (See Annexes 1 and 2.)

Ratio of 1 surgeon: 4 clients: 4 preparation/surgical assistants: 1 anaesthesia/suture provider.

- 1 surgeon working between four surgical bays is trained in all aspects of male circumcision surgery but primarily performs marking, placement of forceps, excision of the prepuce, haemostasis, and placement of mattress sutures.
- 4 preparation/surgical assistants each assigned to a client in one of four surgical bays and trained in patient education, surgical preparation and draping, and surgical assisting.
- 1 anaesthesia/suture provider rotating between the four surgical bays. The anaesthesia/suturing provider is trained in the injection of local anaesthetic and placement of simple interrupted sutures.

The preparation/surgical assistant providers brief the clients on the procedure, clean and drape, assist the surgeon during surgery, bandage the surgical site, and provide postoperative counselling and instructions. The anaesthesia/suture provider has two roles that are separated in time: administering the local anaesthesia and placing the simple interrupted sutures after the surgeon finishes the mattress sutures. The anaesthesia/suture provider moves ahead of the surgeon from one surgical bay to the next as surgeries progress, and returns to the previous bay to complete suturing once the surgeon has finished placing the mattress sutures.

This model may not be appropriate for all facilities or programmes. However, similar efficiencies may be achieved through fine-tuning of staffing responsibilities and ratios. This model is most appropriate when using the forceps-guided surgical method. Similar staff ratios may be used for the dorsal slit method.

Initial experience from a Swaziland PSI site that uses the sleeve method suggests that efficiency may be optimized when one surgeon is allocated to three clients in separate surgical bays and four ancillary staff. That is a ratio of: 1 surgeon : 3 clients : 3 preparation/surgical assistants : 1 anaesthesia/suture provider.

Staffing ratios and numbers should reflect changing demand for services, and adjustments should be made accordingly.

3. Optimizing the use of facility space

Efficient service delivery models can be implemented in relatively small spaces and in either fixed or temporary settings. The allocation of cubicles per surgeon depends on the surgical technique used since different techniques require varied times to complete the whole operation (Table 1). The number of surgical cubicles also depends on the turnaround time of clients, including their preparation time.

While efficiency may vary with facility design and/or setting, health-care personnel time is optimized when each surgeon or surgical team is allocated to more than one surgical bay. The allocation of multiple surgical bays per surgeon helps to minimize the idle time of health-care personnel. These personnel, especially the surgeon, should not have to wait for extended periods to perform surgical tasks between one patient and the next.

Turnaround time, i.e. the time required to move the patient postoperatively from the surgical bay to recovery, disinfect and restock the surgical bay for the next surgical case, and prepare the next patient on the bed, should be factored into the time considerations for surgical bay allocations. The chosen surgical method/clinical techniques, as well as the degrees of task-sharing, should also be factored into the allocation of surgical bays per surgeon/surgical team. Surgical methods and clinical techniques that are quicker require less time per case for the surgeon and equate to a greater number of beds that an individual surgeon may service.

Experience and initial time and motion observations at Orange Farm, South Africa, demonstrate that generally a surgeon's time can be maximized when one surgeon is allocated to four surgical beds. The forceps-guided method is quicker to complete then the other two surgical methods and therefore the time the surgeon spends in the cubicle operating on the client is usually less than with the dorsal slit or the sleeve methods. In the other methods a slightly adjusted ratio of surgeon to surgical bays is necessary (fewer surgical bays per surgeon). The increased technical nature of these methods requires the doctor to spend more time operating in a cubicle before moving on, and they also allow more time for the cubicle to be prepared for the surgeon's return. The ratio could therefore be adjusted to three surgical bays to one surgeon or two surgical bays to one surgeon.

Thus the number of surgical cubicles needed per surgeon depends on the time the surgeon operates in a cubicle and the speed and efficiency needed to turn over and prepare the cubicle.

The ratios given are only guidelines: each facility should consider the space available for surgery and the surgical technique used, and should determine the ratio and facility design to maximize efficiency.

The allocation and utilization of facility space must ensure that adequate infection prevention practices are possible, as indicated in the WHO quality assessment toolkit.[6] The allocation of

space and the design of surgical bays must also ensure that clients' privacy and confidentiality are guaranteed, e.g. there should be curtains or partitioning between bays.

Annex 3 gives an example of a layout and design for a facility employing the forceps-guided model with one surgeon allocated to four bays.

4. Client considerations

4.1 Client flow

Coordinated client flow through the facility is important to avoid congestion and confusion and serves to save client and staff time. The client flow should also be designed to minimize client contact with biohazardous surgical waste. Ideally, clients should have easy access to separate entry and exit points to the clinic at opposite ends. A recovery area should also be available close to the exit to allow clients to rest and be monitored if the need arises. The exit point should be situated close to a place where the client can easily be given, in private, postoperative counselling, an information leaflet about postoperative instructions and complications, and a follow-up appointment. Client flow can also be enhanced by having analgesics provided by a dispensary as the clients are on their way out.

Although the MOVE document highlights options for maximizing client flow and scheduling with regard to the actual male circumcision surgery, client flow is important for all other components of the minimum package of services involving male circumcision for HIV prevention, and other component services should also be taken into account when considering client flow. Annex 4 provides an illustration of a layout that facilitates client flow.

4.2 Client scheduling

Scheduling is a key factor in maximizing efficiency. If individual appointments are made and not kept there may be periods of minimum work and periods of overwhelming catch-up. For example, if bookings are given on an individual basis at hourly intervals, clients who do not arrive on time cause the surgical team to operate at reduced capacity or even remain idle. If a client arrives after his appointment time and another client has been scheduled, the surgical team may not be able to catch up on all the late appointments in a limited time and will have to schedule some clients for another day.

Sector booking may be preferable for some communities and facilities, particularly in communities where the time culture is relaxed and people are not used to keeping on time. With this method of scheduling, the working day can be divided into sectors, e.g. sector 1 from 08:00 to 11:30, sector 2 from 11:30 to 15:00 and sector 3 from 15:00 to 18:30. Staff daily schedules including start, closure and break times should be coordinated to provide standard working hours and break times. Clients booked for a specific sector should be asked to arrive at the starting time for that specific sector, for example all sector 1 clients should be asked to arrive at 08:00. This saves both client and staff time. Clients do not have to come at a specific time and staff attend to the clients in the order they arrive within the specific sector. The maximum waiting time for the client is usually the duration of the sector, i.e. 3 ½ hours. Sector booking is preferable to mass daily booking, as is the practice in many clinics in the developing world, where all clients booked for the day are asked to arrive early in the morning. This results in most of them having to wait for long periods before being attended to.

Sector booking allows the facility to anticipate a more steady work volume. The number of clients booked per sector can be refined over time to achieve optimum efficiency.

5. Supply chain management

The efficiency of services also relies on appropriate material commodities being available for their delivery. It is important to consider:

- the bundling of commodities;
- the forecasting of supply needs;
- procurement;
- distribution.

5.1 Bundling of commodities (sets, packs, kits, modules)

The bundling of commodities that are required to perform a single male circumcision offers a number of advantages contributing to improved efficiency (Table 3). The commodities may be:

- **disposable** (consumable materials, e.g. gauze, needles, scalpel blade and gloves; and surgical instruments made for once-only use); or
- **reusable** (e.g. surgical instruments made for repeated use, with sterilization between surgical cases).

For clarity throughout this section, bundled consumable materials (gauze, needles, scalpel blade, gloves, etc.) are referred to as a ***consumables pack***. Bundled surgical instruments (whether disposable or reusable) are referred to as an instrument set. A consumables pack is combined with an instrument set to create a male circumcision kit, comprising virtually all the commodities necessary to perform a single male circumcision operation. The term module refers to the bundling of other supplies that are essential for providing safe male circumcision services of high quality but are not restricted to being used for single male circumcision cases. Modules contain supplies such as infection prevention accessories, operating theatre equipment and emergency medical supplies.

Consumables pack	Bundled consumable materials such as gauze, needles, scalpel blade and gloves that are used in a male circumcision operation and then discarded. The items are disposable.
Instrument set	Bundled surgical instruments that are used in a male circumcision operation. The items may be disposable or reusable.
Male circumcision kit	Combination of a consumables pack and an instrument set. A male circumcision kit is needed for each male circumcision operation.
Module	Bundled supplies that are used for infection prevention, the furnishing of operating theatres and the management of emergency medical situations. The items may be disposable or reusable.

The three key factors determining kit contents are: the surgical technique (dorsal slit, sleeve resection or forceps-guided); the use of disposable or reusable surgical instruments; and the use of diathermy.

During a technical consultation on male circumcision commodities organized by PEPFAR in Washington DC[7] it was agreed that the contents of the consumables pack should be standard across all three surgical methods. However, there should be variability in the contents of the instrument sets to allow for the different surgical instrument needs of the methods. All male circumcision kits are suitable to be used with diathermy.

Kit 1 includes the standard consumables pack and the reusable surgical instrument set for the forceps-guided method.

Kit 2 includes the standard consumables pack and the reusable surgical instrument set for the sleeve resection and dorsal slit methods.

Kit 3 includes the standard consumables pack and the disposable surgical instrument set for the forceps-guided method.

Module 1 includes supplies needed for infection prevention.
Module 2 includes operating theatre equipment.
Module 3 includes emergency medical management supplies.

Regardless of the kit chosen, male circumcision sites should also order Modules 1, 2 and 3.

A country, programme or facility may choose between the following three purchase options for male circumcision commodities in order to run a site efficiently.

Purchase option 1: kit 1 (standard consumables pack and reusable instrument set for forceps-guided method) + module 1 (infection prevention) + module 2 (OR equipment) + module 3 (emergency medical supplies)

Purchase option 2: kit 2 (standard consumables pack and reusable instrument set for sleeve resection and dorsal slit methods) + module 1 (infection prevention) + module 2 (OR equipment) + module 3 (emergency medical supplies)

Purchase option 3: kit 3 (standard consumables pack and disposable instrument set for forceps-guided method) + module 1 (infection prevention) + module 2 (OR equipment) + module 3 (emergency medical supplies)

(For detailed contents see Annex 5)

Currently, a fully disposable male circumcision kit (disposable consumable materials and disposable surgical instruments) is only available for the forceps-guided method. In the future it may also be possible to produce such kits for the sleeve resection and dorsal slit methods.

Reusable instrument sets in kits 1 and 2 would initially be sterilized and transported inside autoclaved sterile boxes. After their first use, instruments would be resterilized/autoclaved and rebundled into instrument sets on site using autoclave storage boxes. The disposable instrument set in kit 3 would be discarded immediately after first use.

If reusable surgical instruments sets are to be employed, it is important to include autoclave(s) in Module 2. It may be possible to leverage buying power and/or price through mass purchasing of autoclaves and other equipment. A centralized sterilization unit in a district or country may be adequate to handle the sterilization needs of an entire area.

The following important broad decisions on the bundling of male circumcision commodities into set + packs/kits have to be made in advance by countries, programmes or facilities.

- A decision is needed on whether the fully disposable kit 3 is desirable. There are many advantages of using a fully disposable kit (Table 3). However, opting for such a kit necessitates the exclusive use of the forceps-guided method. Moreover, because the surgical instruments in disposable instrument set 3 are intended for single use, some may be made of plastic and/or of inferior quality.
- Alternatively, an autoclave and associated sterilization processes and expenses would have to be included if there were a preference for a kit with contents comprising a consumables pack and a reusable instrument set.

The advantages and disadvantages of fully disposable kits and kits with reusable instruments are outlined in Table 3.

TABLE 3. ADVANTAGES AND DISADVANTAGES OF MALE CIRCUMCISION KITS WITH DISPOSABLE AND REUSABLE SURGICAL INSTRUMENTS

	Male circumcision kits with disposable instruments and consumable materials	Male circumcision kits with reusable instruments and consumable materials
Advantages	• Ensures high quality, sterile condition of all contents in both non-hospital and hospital settings • Logistically and operationally friendly • Facilitates ease of supply management and stockroom control because of fewer individual supplies • Reduces loss of instruments by decreasing access points for the theft of components • Improvement in supplier management, minimizing reliability issues and breakdowns in the supply chain • Ease of use in conjunction with mobile outreach services, especially in resource-poor settings • Key variable in MOVE models, which minimize staff time needed to prepare patients for surgery and staff time spent in the processing (cleaning and packaging) of instrument sets • Reduces start-up programme costs • Elimination of autoclave maintenance costs and washing facilities, saving on water and electricity if the kit is completely disposable (i.e. no reusable instruments)	• In an emergency, surgical components could easily be used for procedures other than male circumcision • Modifications can be made to improve efficiency, including reducing the number of instruments and having all required elements in one pack • Additional modifications can be made to improve efficiency, including preparing the packs at a central unit for smaller circumcision centres and developing a system for the collection of reusable instruments • Reduces recurring costs because instruments can last a long time
Disadvantages	• Environmental concerns because of increased production of medical waste if kits include disposable instruments • Removal of component(s) for procedures other than male circumcision contaminates all remaining kit contents • Recurring costs for purchase of instruments	• Require substantial resources, including adequate storage space for sterile and non-sterile packs, equipped sluice and sterilization rooms, a more complex instrument-tracking system, laundry facilities, and more on-site personnel • All nursing staff must be trained in the processes of decontamination, disinfection, packing and sterilization, as well as in instrument-tracking • In resource-limited settings, autoclaves are often poorly monitored and maintained, instrument quality is poorly monitored, and clean water and regular electricity are not always available

To improve efficiency various important factors should also be considered when commodities are bundled into packs, sets and kits, including the following.

- In order to keep costs low the pack/set/kit contents should be limited to the commodities that are absolutely essential for providing safe male circumcision surgery of high quality.
- Items should not be individually sterilized but should be bundled into a package and sterilized as a unit. Supplies in the disposables pack should be bundled and sterilized in highly specialized, certified clean rooms and there should be a method for verifying the sterility of the package.
- Requirements for waste disposal should be anticipated and plans made to address related issues appropriately. Particularly in high-volume service settings, the volume of medical waste could be substantial.
- Medications and iodine should not be included in the consumables packs/kits because regulations on medications differ between countries and because of the added complexity of tracking expiry dates.
- A separate bulk supply of individual items should always be readily available in case an item is not usable or is missing from a package. Also, a surplus of sterilized kits (packs and sets) should be on hand in case an entire pack and/or set is compromised or no longer sterile.

5.2 Forecasting supply needs

As historical data are limited it is difficult to anticipate demand for male circumcision and to forecast future supply volumes, whether supplies are bundled or not. Nevertheless, an efficient system for providing services depends on a continuously improving mechanism for anticipating future supply needs. The extent to which service providers will experience a wave of early adopters of male circumcision, followed by a plateau or decline in demand, is not known and may vary by country and region. Expertise is available in matters of supply forecasting, and expert technical assistance should be sought. In addition, programmes preparing to launch service delivery should anticipate their need for infection prevention commodities, operating theatre equipment and emergency medical supplies.

5.3 Procurement

An efficient system for procuring commodities bundled into sterilized sets/packs/kits is essential. It is probably impracticable for individual service providers to form relationships with a multitude of suppliers and to find separate mechanisms for bundling, sterilization and shipping, and in any case this would not be very cost-effective. Programmes should share experiences learnt in this area, and where possible should combine their efforts through a minimal number of agents already knowledgeable in supply chain issues.

5.4 Distribution

Programmes that provide male circumcision services in multiple locations and settings have the same complexities of coordinating the distribution of supplies, whether these are bundled into kits or not. Expertise is available in matters of supply distribution, and expert technical assistance should be sought.

6. Cost efficiencies

The strategies outlined in this document have been described in terms of time efficiencies gained through implementation, yet there are important cost efficiencies to consider as well. Governments and NGOs seeking to expand access to male circumcision services are likely to encounter financial constraints. Minimizing per-client costs can extend the reach of the available funds.

Since human resources are a significant driver of per client costs, activities that reduce the time requirements of staff, particularly staff with relatively high salaries, can lead to cost efficiencies. For example, if a facility utilizes a task-shifting model in which a clinical officer or nurse completes all steps of the surgery, the per-client costs are likely to be lower than if a physician were used. Such a facility may therefore not save much more by task-sharing. Similarly, since the use of diathermy reduces the time that a surgeon spends on each surgery, he or she can complete more surgeries each day and thus reduce per client costs. The extent of these cost efficiencies will be highly dependent on pay structures and differentials in a given country.

Computer modelling can be used to estimate per-client and overall costs under a given service delivery model, and to calculate the cost efficiencies gained from adjustments to the model. With these tools, programme planners can more accurately assess the financial impact of alternative strategies and thus inform programme design.

7. Quality assurance

Quality assurance is an important part of MOVE. The provision of high-volume efficient services does not mean that quality or safety can be compromised. Quality assurance processes should be adopted and implemented in all MOVE facilities. These facilities should strive to meet the WHO-recommended quality assurance standards and criteria. [4,6]

7.1 Service standards

Standards define the desired performance for a health-care system or service and provide the basis for measuring quality. The service standards for male circumcision define the necessary elements for providing safe care of high quality. The standards are system-based, i.e. they are designed to encompass all the elements of service delivery which affect the quality and outcome of male circumcision. The WHO-recommended standards (*Box 2*) address inputs and processes for male circumcision services.

Box 2. Recommended male circumcision service standards

Standard 1. An effective management system is established to oversee the provision of male circumcision services.

Standard 2. A minimum package of male circucmcision services is provided.

Standard 3. The facility has the necessary medicines, supplies, equipment and environment for providing safe male circumcision services of good quality.

Standard 4. Providers are qualified and competent.

Standard 5. Clients are provided with information, education and counselling on HIV prevention and male circumcision.

Standard 6. Assessments are performed to determine the condition of clients.

Standard 7. Male circucmsion surgical care is delivered according to evidence-based guidelines.

Standard 8. Infection prevention and control measures are practised.

Standard 9. Continuity of care is provided.

Standard 10. A system for monitoring and evaluation is established.

The minimum package of male circumcision services (*Box 1*) should be available in all facilities providing male circumcision. The implementation and monitoring of the provision of the minimum package at facility level should be part of the quality assurance process. These services could be offered in different locations within the same facility. However, systems and processes should be established to facilitate easy client flow and referral from one point to another. More comprehensive packages could be offered, depending on the facility and the prevailing problems in the community.

7.2 Clinical protocols and guidelines

Clinical protocols and guidelines are essential for ensuring that health-care providers give care and treatment based on current evidence. They help to standardize and simplify supervision and quality assurance tasks. Irrespective of where providers have been trained, they should all use the same standard methods and follow the same protocols. The selection of a standard surgical approach that is simple, safe and effective, requiring minimal specialized skills, helps to reduce the probability of complications and allows the possibility of appropriate task-shifting to health-care cadres with lower qualifications. A MOVE facility should follow recommended clinical protocols and guidelines provided in the WHO/UNAIDS/Jhpiego *Manual for male circumcision under local anaesthesia*. Some modifications and adjustments relating to the use of personnel time and skills are suggested in this document with a view to improving efficiency. (See Annex 1 for modifications for high-quality, high-volume services.

7.3 Infection prevention

Because increased volume is an objective of improved efficiency, increased numbers of patients and staff will be in close proximity to one another and biohazards/infectious waste. As in all clinical settings, infection prevention precautions are paramount. WHO's quality assurance guide and toolkit[4, 6] address infection prevention in male circumcision for HIV prevention service settings, and the recommendations should be closely followed.

7.4 Monitoring and evaluation

Adverse event monitoring and reporting are a critical element of quality assurance. All adverse events during and after surgery should be recorded. A regular review of adverse events per surgeon should be conducted, and feedback and training should be given with a view to reducing the rates of adverse events. Although a team approach is used in MOVE to deliver the surgical steps, the surgeon is ultimately responsible for the activities of her or his surgical team and case review results should be disseminated to staff accordingly. Regular assessment of staff competence is one way of monitoring staff practice and providing supportive supervision in order to keep the rate of adverse events low. WHO monitoring and evaluation guidance for male circumcision services provides a comprehensive overview of indicators for monitoring male circumcision services at the country and facility levels.[8] In addition, MOVE facilities should monitor the total number of operations performed each day at a site, the number of operations performed each day per surgeon, the average time a surgeon spends in a surgical bay, the average time a patient spends in a surgical bay, and the surgical bay turnover time. Results should be periodically evaluated to gauge performance, identify areas for improvement, and refine performance targets.

8. Annexes

Annex 1. High-quality, high-volume (HQHV) adult male circumcision standard operating procedures: surgery, surgical area, surgical kit

Based on the surgical steps outlined in the WHO/UNAIDS/Jhpiego *Manual for male circumcision under local anaesthesia*, the summary below indicates how HQHV MC/MOVE differs from the standard approach to male circumcision surgery. Only the clinical/surgical steps are outlined.

Normal text is used for standard parts of the adult male circumcision surgery protocol.
The italic text indicates procedure elements specific to adult male circumcision HQHV.
The lighter text explains the reason for these HQHV elements.

1. Procedure (forceps-guided)
   a. The patient removes his clothes and undergarments from the waist down.

   b. A pad is placed under the patient to absorb any fluids.

   c. The patient is again examined for STI/genital abnormalities prior to penile block (***by the designated team member***). Reliance for this examination on a team member other than the surgeon reflects the HQHV strategy of assigning tasks requiring moderate skill levels to mid-level personnel, thereby reserving scarce surgeon time for the most technically demanding tasks.

   d. The base of the penis is cleansed with alcohol and a penile block is performed, preferably with ***5 ml 0.25% bupivicaine mixed with 5 ml 2% lignocaine***, with a total of approximately 8 ml injected; 1–2 ml should be left in the syringe to supplement the block if it proves inadequate during the operation. ***This can be performed by any properly trained team member.*** The specified mixture of two anaesthetics provides a longer numbing duration, essential in HQHV because the patient may wait longer for the surgery. The use of a team member other than the surgeon is a standard part of the HQHV team strategy.

   e. A ***team member***, wearing sterile gloves, prepares the client's skin with betadine solution. The preparation must cover the inner surface of the prepuce and the glans. If phimosis is present, additional betadine solution should be placed on the field so this area can be cleansed once the foreskin is removed. The gloves worn for preparation should be disposed of prior to the procedure. Again, a team member who is appropriately trained can perform this task.

   f. It is recommended that the surgeon wear personal protective equipment including a clean apron, eye and mouth protection and a surgical cap. The apron should be changed between procedures ***if soiled***. Not changing aprons (if not soiled) allows rapid but safe progression between patients.

g. The surgeon ***and other team members assisting during sterile portions of the procedure***, after undergoing a surgical scrub, don sterile gloves in routine fashion. ***Between patients, hand-washing with an alcohol-based handrub is acceptable as an alternative to a surgical scrub***. WHO guidance supports the alcohol-based handrub in the absence of visible materials to be cleaned. The handrub is quicker than a scrub, thus allowing rapid and safe progression to the next patient.

h. A sterile drape is placed over the field and this sterile field is maintained throughout the procedure.

i. The adequacy of the block is checked and revised as necessary.

j. With the foreskin over the glans the line of the corona of the glans is visualized through the foreskin and this line is marked gently with artery forceps. This will be the incision line.

k. The prepuce is grasped with two forceps at 3 and 9 o'clock and held on stretch. ***This task can be performed by an appropriately trained surgical assistant***. The glans and incision lines are identified. Above the glans and just proximal to the marked incision line, straight forceps are applied across the foreskin. The glans is again palpated with the thumb and forefinger to ensure that it is free from the clamp.

l. A scalpel is used to cut on top of the clamp, removing the foreskin.

m. The foreskin is released and the skin retracted. Bleeding points from the tissue bed are identified and haemostasis is achieved using ***judicious monopolar diathermy or interrupted sutures. If monopolar cautery is used the superficial tissue containing the bleeding vessel should be grasped and elevated with forceps, minimizing electrothermal spread along adjacent tissue, with cautery applied to the forceps for approximately 0.5 seconds.*** The use of cautery can reduce AMC time by 5–8 minutes as compared with clamping and suture ligation.

n. Once haemostasis is achieved the skin edges of the frenulum and ventral penile raphe are reapproximated (at the 6 o'clock position) using a horizontal mattress suture. Care should be taken as this area is adjacent to the urethra and also prone to bleeding. Haemostasis should be excellent in this area and sutures must not be placed too deep, compromising the urethra. It is helpful to tag the tail of this suture for use in retraction later.

o. The skin edges at the 12 o'clock position are reapproximated using either vertical mattress sutures or simple interrupted sutures. The skin should be evenly distributed between the 12 and 6 o'clock sutures to prevent torsion of the penile skin. It is helpful to tag the 12 o'clock suture tail after placement. Holding the 6 and 12 o'clock suture tails on opposite tension with forceps aligns the skin edges and facilitates the placement of sutures while keeping the assistant's hands out of the field.

p. ***At this point, an assistant may take over suturing and the surgeon may move to the next patient.*** As noted above, reliance on team members other than the surgeon is a core technique for HQHV surgery. Suturing is a skill that can be readily trained (and verified). The four mattress sutures (3, 6, 9 and 12 o'clock) are critical for proper alignment of the foreskin, and the surgeon should place these sutures. The remaining sutures are less technically challenging and their placement may be a task shared with non-physician health-care cadres. These one or two additional simple interrupted sutures should be placed between each of the mattress sutures. If bleeding from the skin edges or poor skin apposition is apparent, additional interrupted sutures should be placed as needed.

q. The penis is then dressed ***by a non-surgeon team member.*** Petroleum-impregnated gauze is wrapped around the proximal corona of the glans and over the incision line. Care should be taken to include the frenulum as this area is prone to significant swelling. The gauze should not obstruct the urethral meatus of the glans. Sterile dry gauze is then wrapped with slight pressure around the proximal corona and incision line. ***A 4-inch piece of cohesive bandage (COBAN) is then gently wrapped around the penis to provide light pressure for haemostasis.*** This bandage is important in the HQHV setting because of the use of fewer sutures than might be used otherwise. It assures adequate haemostasis and wound stability.

   The corona, frenulum and incision line should have most pressure from the dressing with lighter pressure towards the base so that blood return from the suture line to the base of the penis is not restricted. Tape is used to secure the gauze in place; however, tape should NEVER be put circumferentially around the penis as this may constrict the penis and cause glans necrosis. The penis and dressing can then be taped up on the abdomen to elevate and help prevent swelling.

r. If there is an intraoperative complication or deviation from standard surgical practice, a corresponding form should be completed.

2. Postoperative care and instruction

a. ***This can be done in a separate area, outside the surgical area, to maximize patient throughput***. Removal of the patients from the operating theatre permits adequate patient turnover (throughput) for HQHV methods.

b. The patient is given:
   i. pain medication (20 tablets paracetamol);
   ii. written postoperative instructions;
   iii. a medical certificate for absence from work or school if needed.

c. The patient is discharged from the centre.

3. Follow-up care

a. If a COBAN dressing is applied, it should be removed 2–3 days postoperatively by the patient.

b. The patient should answer the follow-up questionnaire. The wound is examined ***by a team member 7 days postoperatively*** and any concerns of the patient are addressed. Necessary paperwork is completed.

c. If an adverse event occurs the appropriate form will be completed by a physician and signed by the medical director of the facility.

HQHV surgical area considerations

Typical MC HQHV surgical area layouts conforming to the following guidelines are illustrated in Annex 4. The layout is important to HQHV because of the need to facilitate efficient flow of patients, staff movement among patients, and access to surgical tools and handrubs.

1. ***The operating theatre (OT) should be well ventilated and have good lighting.*** These features are useful in all OTs, but especially so for HQHV because of the high and spatially dispersed activity. Ventilation is essential because of the relatively large number of staff and the large amount of movement. Lighting must be appropriate for multiple operating locations and for movement among locations.

2. ***The OT should be an open area of approximately 8 by 3.5 metres, or 4 by 7 metres (for four surgical bays and one circumciser).*** Proper sizes are necessary for acceptable operating space and room to manoeuvre patients and staff among and through surgical bays. (*See layout diagrams in Annex 4.*)

3. *There should be an area of at least 2 by 1 metres within the OT for disposal of medical waste, separate from patient care areas.* With a relatively high rate of waste generation, this space will permit safe accumulation of waste during the surgical session, to be moved to the next step in disposal afterwards.

4. *Separate access for patient entry and exit is preferred in order to simplify and maximize patient flow. Space outside the OT should be configured accordingly for preoperative and postoperative activities.* Simple, unidirectional patient flow paths facilitate patient throughput. The use of a single point of entry and egress would slow this process.

5. *There should be at least four surgical bays per surgeon per OT so as to optimize surgeon productivity by minimizing downtime between patients. Six beds permit more time for patient preparation (sterile field preparation, anaesthetic), surgery and haemostasis with a pressure bandage. Four bays can achieve the maximum efficiency.* The use of at least four surgical bays is a core feature of HQHV MC. It allows the surgeon to move continuously through patients, with enough time before surgery to anaesthesize and clean the surgical area, and enough time afterwards for haemostasis. Using six beds may further increase team productivity, especially if a suture nurse is used after the main circumciser places the initial two stitches.

6. *Each surgical bay should be at least 2.5 by 2 metres and separated by an opaque curtain, preferably plastic. The bay should be wide enough to accommodate an operating table with a surgeon and assistant standing on opposite sides.* This arrangement assures adequate space for the coordinated actions of the assistant (pre-surgeon and post-surgeon) and of the surgeon with help from the assistant (during the middle of the procedure).

7. *Each surgical bay should have an instrument table.* HQHV is more efficient if the instrument table does not have to be moved between surgical bays.

8. *The surgical kits with instruments and sutures should be open and ready before the arrival of he surgeon.* This allows the surgeon immediately to place the clamps and remove the foreskin, minimizing surgeon time per patient.

9. *Each bay should contain a monopolar cautery machine, if available in this setting, and a new sterile monopolar tip should be used for each patient.* Cautery machines are much quicker than ligature to close off bleeders, and thus reduce surgeon time and increase the productivity of the team. They are used by the circumciser.

10. *Alcohol handrub should be readily available in at least three locations in the OT, near all surgical bays.* Rapid and convenient sterilization between patients is vital for surgeon and staff flow in HQHV.

Annex 2. Efficiency model case study: Bophelo Pele Male Circumcision Project, Orange Farm, South Africa

Orange Farm is a semiurban area of 25 km^2 with a population of about 150 000. The Bophelo Pele Project, which is funded by ANRS (France), aims to offer free and safe male circumcision to all adult men of this community. The project started after an initial community mobilization in 2007.

General information on male circumcision is delivered to male and female residents of Orange Farm using local radio announcements, pamphlet distribution to every household and community meetings. Men willing to undergo circumcision and women are welcome in outreach centres located throughout the community, where they receive risk-reduction counselling and detailed information on male circumcision, and are offered HIV screening by means of rapid tests and an immediate CD4 count if they test positive. Men are circumcised at least three days after counselling, in the Bophelo Pele Male Circumcision Centre located in the township. Treatment of symptomatic STIs is provided if necessary.

Male circumcisions are performed in a room equipped with seven beds separated by curtains. Cost has been reduced to R 300 (approximately US $35) per circumcision by using the forceps-guided method with a surgical disposal kit and monopolar diathermy and by optimizing the use of personnel.

A surgical team is composed of a) one surgeon to apply the forceps, cut the foreskin, control the bleeding and supervise staff and b) five nurses to administer local anaesthesia, assist during surgery and complete the suturing. With this team composition, 6–10 male circumcisions can be performed per hour, with an average surgeon time of 7½ minutes per circumcision and a total procedure time of 20 minutes. Clients receive oral and written postoperative instructions. Follow-up visits are conducted in a private room at the surgical centre on day 2 and day 7 after surgery. Clients missing a follow-up visit receive phone reminders. Client bookings for male circumcision range from 30 to 100 per day. After more than 7000 male circumcisions within 11 months no death or permanent injury attributable to adverse events was observed. Eight participants (0.14%) were hospitalized for adverse events such as bleeding and infection. The total complication rate, including minor complications such as pain, bleeding, local infection and swelling, was 2.7%. External quality control based on the *WHO quality assessment toolkit* is organized regularly.

The Bophelo Pele Project is designed to be a safe and cost-efficient model for rolling out surgery on a large scale as a public health intervention in a semi-urban setting where a high volume of surgeries is required. The Project demonstrates that the roll-out of adult male circumcisions can be done safely, efficiently and inexpensively according to international recommendations.

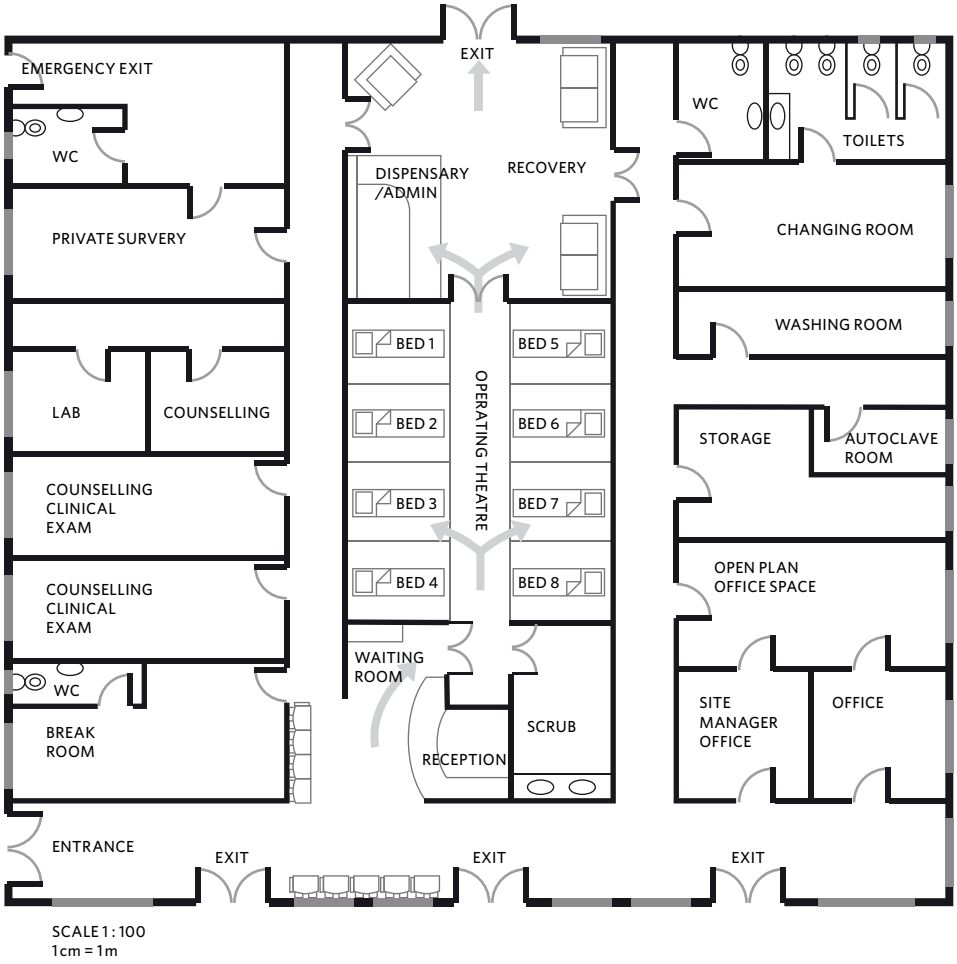
Annex 3. Efficiency model case study: Aravind Eye Care System, India

The Aravind Eye Care System in Madurai, India has refined the methods of high-quality and high-volume cataract removal over several decades. The programme has engaged in continuous innovation guided by rigorous evidence review to identify best methods. All steps from training and community recruitment to patient intake, surgery and recovery employ explicit systems to maximize the services provided, contain costs and assure world-standard care. The Aravind method, employed in a single facility in the 1970s, now encompasses five hospitals, three managed eye hospitals, a manufacturing centre for ophthalmic products, and an international research foundation. Through its resource and training centre the Aravind method has been adopted in more than 200 hospitals worldwide, including ones in Africa.

The surgery itself relies on a team approach. Lower health cadres conduct the majority of steps in the surgery, before and after the surgeon conducts the delicate cataract removal and artificial lens implantation.

A patient is prepared for surgery in an anaesthesia room, where a specially-trained provider administers a retro-orbital block for local anaesthesia. The patient is then transported into the surgical theatre. A senior surgeon operates on two side-by-side tables with a scrub nurse at each. While the surgeon operates on one table (table 1) assisted by one nurse, another nurse drapes and prepares the second patient up to the bridle suture on table 2. When the procedure on table 1 is over, the assistant gives the subconjunctival injection and bandages the patient. The surgeon, after disinfecting her or his gloves, moves on to table 2, where the next patient is ready for surgery. Thus the output of a surgeon with a single microscope is almost doubled. An experienced surgeon can perform 6–8 extracapsular cataract operations in an hour.

Annex 4. Layout and design for a facility employing the forceps-guided model with one surgeon allocated to four bays



Annex 5. Lists of commodities and supplies

Kit 1: Set of reusable surgical instruments plus pack of consumables

Needed for any site choosing to use the forceps-guided surgical technique. Add to this list: module 1, module 2 and module 3.				
Item #	Name of item	Product specification	Quantity	Remarks
Set of reusable surgical instruments in autoclave storage box				
1	Autoclave storage box	Size of box might vary depending on the final selection of instruments (lengths can vary) as well as in-country pilot testing (as some tiny autoclaves might not accommodate a large box) Estimated size approximately: 5 x 10 x 2 inches.	1	
2	Combination needle-holder/ suture scissors	Combination needle-holder/suture scissors: total length 13–15 cm, working surface aproximately 20mm. (Example: Olsen-Hegar needle-holder scissors, 5.5 inches (14cm))	1	If this instrument cannot be obtained affordably then both suture scissors and a needle-holder/driver will be required
	or needle-holder	Needle-holder/driver: total length 12–14 cm, working surface 20mm (Example: Baumgartner needle-holder)	1	Either a combination of needle-holder and scissors is needed or separate needle-holders and scissors, depending on price and availability
	and suture scissors	Suture scissors: total length 12–15 cm. (Example: Mayo scissors)	1	Either a combination of needle-holder and scissors is needed or separate needle-holders and scissors, depending on price and availability
3	Toothed tissue forceps	Toothed tissue forceps (AKA pick-ups, dissection forceps): total length 13 cm, working surface 15 mm, serrated, (Example: catalogue number EF 15998B)	1	
3	Mosquito clamps straight	Mosquito clamps straight (AKA 'Snaps', mosquito forceps, haemostatic forceps): total length 12–14 cm, working surface 20–30 mm. (Example: Halstead mosquito)	4	
4	Mosquito clamps curved	Mosquito clamps curved (AKA 'Snaps', Mosquito forceps, haemostatic forceps): total length 12–14 cm, working surface 20–30 mm. (Example: Halstead mosquito)	1	
5	Forceps haemostatic cross-clamp	Circumcision forceps haemostatic cross-clamp: total length 20 cm, working surface 64 mm. (Example: Rochester Pean forceps, code 14-405)	1	
Pack of essential consumables in multipurpose recyclable plastic container tray				
1	Multipurpose container tray	Stable recycled plastic tray to conduct procedure, minimum 700 micron virgim plastic, with 4 compartments (compartment 1 = 13 x 26 cm, compartment 2 = 5 x 8 cm, compartment 3 = 5 x 5 cm, compartment 4 = 5 x 13 cm and the total size of the tray is 26 x 18 cm)	1	
2	O-drape	Disposable O-drape 100 x 75 cm (one side absorbable and one side impermeable; the two sides should be fused together and not lint).	1	
3	Scalpel blade with handle	Disposable scalpel and handle (retractable and lockable): blade type 23, total length 11 cm.	1	Example: Medisafe safety scalpel
4	Gauze, plain	Gauze swabs 100 x 100 mm (12-ply)	20	
5	Gauze, petroleum jelly impregnated	Paranet gauze 10 cm x 10 cm (1-ply)	1	
6	Syringe	Syringe 10 ml	1	
7	Injection needles	Needle 21 g and 23 g, 1.5 inch	2	

8	Suture, braided/ absorbable	Suture 3/0 braided synthetic (polyglycolic acid suture) 75 cm, on reverse cutting needle 26 mm.	2	Example: vicryl, polysorb
9	Surgical gloves	Sterile surgical glove sizes 8 and 7½	2	
10	Apron, disposable	Apron, plastic disposable, quality of the trash bag.	2	
11	Alcohol swabs	1 ¼ x 2 ½ inches, isopropyl alcohol 70%.	2	
12	Surgical tape	Surgical paper tape micropore 12 mm, length 1–3 m.	1	
13	Sterile prep gloves	Examination gloves, large.	1	
Packaging and sterilization of the pack				
14	Surgical crepe paper	Pack is wrapped in surgical crepe paper 60 x 60 cm.	1	
15	Indicator bag and sterilization	Pack EtO sterilized in a 0.3 µ sterilization indicator bag with the expiry date of items clearly indicated. **All items in the pack must have an expiry date greater than 2 years from the date of delivery, and the pack should have an expiration date of 18 months from the date of delivery.**	1	
These items should be ordered in bulk (outside the set or pack)				
1	Diathermy/cautery tips	Diathermy/electrocautery tips ('electrodes') with blade-type configuration. Disposable.	N/A	Must be compatible with diathermy wand.
2	Lignocaine	Lignocaine 1% 20-ml ampoule (1 ampoule per male circumcision(MC)) or alternatively, 5-ml ampoule (use 2–4 per MC).	N/A	1% is acceptable if Marcaine is used, otherwise 2% is recommended (note: WHO training manual uses plain lignocaine 1%).
3	Marcaine	Marcaine (bupivacaine hydrochloride) 0.5% 10cc bottles (about 3cc per MC needed)	N/A	If used with lignocaine 1%. An alternative can be to use lignocaine 2%.
4	Paracetamol	Sachet with 18 tablets of 500 mg of paracetamol (quantity needed for 1 MC)	N/A	
5	Iodine	Povidine iodine 100 ml Bottle (10% Povidone Iodine solution) (50–100 cc needed per MC)	N/A	
6	Compression bandage	Bandage - cohesive 7.5 m x 4.5 cm 1 x roll Coban	N/A	
7	Sterile gauze	Gauze swabs 100 x 100 mm (12-ply) – **STERILIZED.**	N/A	Excess quantity for instances of excess bleeding, where the 20 swabs in the kit will not suffice.
8	Suture — braided/ absorbable	Suture 3/0 braided synthetic 75 cm, on reverse cutting needle 26 mm. (Example: vicryl, polysorb).	N/A	Excess quantity where more than 2 sutures are needed. This can be the case during training or if there is excessive bleeding.
9	Sterile surgical gloves	Range of sizes: 7, 7.5, 8, 8.5.	N/A	For clinicians whose hands do not fit the sizes provided in the kit and instances where an additional person needs gloves.

Kit 2: set of reusable surgical instruments plus pack of consumables

Needed for any site choosing to use sleeve or dorsal slit surgical technique. Add to this list module 1, module 2 and module 3 .				
Item #	Name of items	Product specification	Quantity	Remarks
Set of reusable surgical instruments in autoclave storage box				
1	Autoclave storage box	Size of box may vary, depending on the final selection of instruments (lengths can vary) as well as in-country pilot testing (as some tiny autoclaves might not accommodate a large box) Estimated size approximately: 5 x 10 x 2 inches.	1	
2	Dissection scissors	Tissue dissecting scissors: total length 13–15 cm. (Example: Metzenbaum scissors curved).	1	
3	Combination needle-holder/ suture scissors	Combination needle-holder/suture scissors: total length 13–15 cm, working surface approximately 20 mm. (Example Olsen-Hegar needle-holder scissors, 5.5 inches (14 cm)).	1	If this instrument cannot be obtained affordably then both suture scissors and a needle-holder/driver will be required.
	or needle-holder	Needle-holder/driver: total length 12–14 cm, working surface 20 mm. (Example: Baumgartner needle-holder)	1	Either a combination of needle-holder and scissors is needed or separate needle-holders and scissors, depending on price and availability.
	and suture scissors	Suture scissors: total length 12–15 cm, (Example: Mayo scissors).	1	Either a combination of needle-holder and scissors is needed or separate needle-holders and scissors, depending on price and availability.
4	Toothed tissue forceps	Toothed tissue forceps (AKA pick-ups, dissection forceps): total length 13 cm, working surface 15 mm serrated. (Example: catalogue number EF 15998B).	1	
5	Mosquito clamps straight	Mosquito clamps straight (AKA 'Snaps', mosquito forceps, haemostatic forceps): total length 12–14 cm, working surface 20–30 mm. (Example: Halstead mosquito).	4	
6	Mosquito clamps curved	Mosquito clamps straight (AKA 'Snaps', mosquito forceps, haemostatic forceps): total length 12–14 cm, working surface 20–30 mm. (Example: Halstead mosquito).	1	
7	Haemostatic clamps	Haemostatic clamps, AKA 'Artery Forceps' (for dorsal slit MC): total length 13–15 cm, working surface 40 mm. (Example: Kelly hemostat – straight).	2	
Pack of essential consumables in multipurpose recyclable plastic container tray				
1	Multipurpose container tray	Stable recyclable plastic tray to conduct procedure, minimum 700 micron virgim plastic, with 4 compartments (compartment 1 = 13 x 26 cm, compartment 2 = 5 x 8 cm, compartment 3 = 5 x 5 cm, compartment 4 = 5 x 13 cm and the total size of the tray is 26 x 18 cm)	1	
2	O-drape	Disposable O-drape 100 x 75 cm (one side absorbable and one side impermeable, the two different sides should be fused together and not lint.)	1	
3	Scalpel blade with handle	Disposable scalpel and handle (retractable and lockable): Blade type 23, total length 11 cm.	1	Example Medisafe safety scalpel.

4	Gauze, plain	Gauze swabs 100 x 100 mm (12-ply)	20	
5	Gauze, petroleum jelly impregnated	Paranet gauze 10 cm x 10 cm (1-ply)	1	
6	Syringe	Syringe 10 ml	1	
7	Injection needles	Needle 21 g and 23 g, 1.5 inch	2	
8	Suture, braided/absorbable	Suture 3/0 braided synthetic (polyglycolic acid suture) 75 cm, on reverse cutting needle 26 mm	2	Example: vicryl, polysorb
9	Surgical gloves	Sterile surgical gloves, sizes 8 and 7½.	2	
10	Apron, disposable	Apron, plastic disposable, quality of the trash bag.	2	
11	Alcohol swabs	1¼ x 2½, isopropyl alcohol 70%.	2	
12	Surgical tape	Surgical paper tape micropore 12 mm, 1–3 m.	1	
13	Sterile prep gloves	Examination gloves, large	1	
Packaging and sterilization of the pack				
14	Surgical crepe paper	Pack is wrapped in surgical crepe paper 60 x 60 cm.	1	
15	Indicator bag and sterilization	Pack EtO sterilized in a 0.3 µ sterilization indicator bag with the expiry date of items clearly indicated. **All items in the pack must have an expiry date greater than 2 years from the date of delivery, and the pack should have an expiration date of 18 months from the date of delivery.**	1	
These items should be ordered in bulk (outside of the set or pack)				
1	Diathermy/cautery tips	Diathermy/electrocautery tips ('electrodes') with blade-type configuration. Disposable.	N/A	Must be compatible with diathermy wand.
2	Lignocaine	Lignocaine 1% 20-ml ampoule (1 ampoule per male circumcision(MC)) or alternatively, 5-ml ampoule (use 2-4 per MC).	N/A	1% is acceptable if Marcaine is used, otherwise 2% is recommended (note: WHO training manual uses plain lignocaine 1%).
3	Marcaine	Marcaine (bupivacaine hydrochloride) 0.5% 10cc bottles (about 3cc per MC needed)	N/A	If used with lignocaine 1%. An alternative can be to use lignocaine 2%.
4	Paracetamol	Sachet with 18 tablets of 500 mg of paracetamol (quantity needed for 1 MC)	N/A	
5	Iodine	Povidine iodine 100 ml Bottle (10% Povidone Iodine solution) (50–100 cc needed per MC)	N/A	
6	Compression bandage	Bandage - cohesive 7.5 m x 4.5 cm 1 x roll Coban	N/A	
7	Sterile gauze	Gauze swabs 100 x 100 mm (12-ply) – **STERILIZED.**	N/A	Excess quantity for instances of excess bleeding, where the 20 swabs in the kit will not suffice.
8	Suture — braided/absorbable	Suture 3/0 braided synthetic 75 cm, on reverse cutting needle 26 mm. (Example: vicryl, polysorb).	N/A	Excess quantity where more than 2 sutures are needed. This can be the case during training or if there is excessive bleeding.
9	Sterile surgical gloves	Range of sizes: 7, 7.5, 8, 8.5.	N/A	For clinicians whose hands do not fit the sizes provided in the kit and instances where an additional person needs gloves.

Kit 3: fully disposable surgical instruments and consumables

Needed for any site choosing to use disposable instrument and forceps-guided surgical technique. Add to this list module 1, module 2 and module 3.				
Item #	Name of items	Product specification	Quantity	Observation
Item 1 to 12 of the kit are disposable consumables				
1	Multipurpose container tray	Stable recyclable plastic tray to conduct procedure, minimum 700 micron virgim plastic, with 4 compartments (compartment 1 = 13 x 26 cm, compartment 2 = 5 x 8 cm, compartment 3 = 5 x 5 cm, compartment 4 = 5 x 13 cm and the total size of the tray is 26 x 18 cm).	1	
2	O-drape	Disposable O-drape 100 x 75 cm (one side absorbable and one side impermeable; the two sides should be fused together and not lint).	1	
3	Gauze, plain	Gauze swabs 100 x 100 mm (12-ply)	20	
4	Gauze, petroleum jelly Impregnated	Paranet gauze 10 x 10 cm (1-ply)	1	
5	Syringe	Syringe 10 ml.	1	
6	Injection needles	Needle 21 g and 23 g 1.5 inch	2	
7	Suture, braided/ absorbable	Suture 3/0 braided synthetic (polyglycolic acid suture) 75 cm, on reverse cutting needle 26 mm.	2	Example: vicryl, polysorb
8	Surgical gloves	Sterile surgical gloves, size 8 and 7 1/2.	2	
9	Apron, disposable	Apron plastic disposable, quality of the trash bag.	2	
10	Alcohol swabs	1 1/4 x 2 1/2, isopropyl alcohol 70%.	2	
11	Surgical tape	Surgical paper tape micropore 12 mm, length 1–3 m.	1	
12	Sterile prep gloves	Examination glove, large.	1	
Items 13 to 18 into the kit are disposable surgical instruments				
13	Combination needle-holder and scissors	Combination disposable needle-holder/suture scissors: total length 13–15 cm, working surface approximately 20 mm.	1	Either a combination of needle-holder and scissors is needed or separate needle-holders and scissors, depending on price and availability.
	or needle-holder	Needle-holder/driver: total length 12–14 cm, working surface 20 mm (Example: Baumgartner needle holder).	1	Either a combination of needle-holder and scissors is needed or separate needle-holders and scissors, depending on price and availability.
	and suture scissors	Suture scissors: total length 12–15 cm, (Example: Mayo scissors).	1	Either a combination of needle-holder and scissors is needed or separate needle-holders and scissors, depending on price and availability.
14	Non-toothed plastic forceps	Non-toothed plastic forceps (pick-ups, dissection forceps): total length 13 cm, working surface 15 mm serrated. (Example: catalogue number EF 15998B).	1	

15	Mosquito clamps, straight	Mosquito clamps, disposable straight (mosquito forceps, haemostatic forceps): total length 12–14 cm, working surface 30 mm. (Example: Halstead disposable straight mosquito)	1	
16	Mosquito clamps, curved	Mosquito clamps, disposable curved (mosquito forceps, haemostatic forceps): total length 12–14 cm, working surface 30 mm.	1	
17	Disposable scalpel and handle	Disposable scalpel and handle (retractable and lockable): blade type 23, total length 11 cm.	1	
18	Circumcision forceps, haemostatic	Disposable circumcision forceps, haemostatic cross-clamp: total length 20 cm, working surface 64 mm.	1	
Packaging and sterilization of the kit				
19	Surgical crepe paper	Pack is wrapped in surgical crepe paper 60 x 60 cm	1	
20	Indicator bag and sterilization	Pack EtO sterilized in a 0.3 µ sterilization indicator bag with the expiry date of items clearly indicated. **All items in the pack must have an expiry date greater than 2 years from the date of delivery, and the pack should have an expiration date of 18 months from the date of delivery.**	1	
These items should be ordered in bulk (outside of the kit)				
1	Diathermy/ cautery tips	Diathermy/electrocautery tips (AKA 'electrodes'), blade-type configuration. Disposable.	N/A	Must be compatible with diathermy wand.
2	Lignocaine	Lignocaine 1% 20-ml ampoule (1 ampoule per male circumcision (MC)) or alternatively, 5-ml ampoules (use 2–4 per MC).	N/A	1% is acceptable if Marcaine is used; otherwise 2% is recommended (note: WHO training manual uses plain 1%).
3	Marcaine	Marcaine (bupivacaine hydrochloride) 0.5% 10 cc bottles (about 3cc per MC needed)	N/A	If used with lignocaine 1%. An alternative can be to use lignocaine 2%.
4	Paracetamol	Sachet with 18 tablets of 500 mg of paracetamol (quantity needed for 1 MC)	N/A	
5	Iodine	Povidine iodine 100 ml bottle (10% Povidone iodine solution) (50–100 cc needed per MC)	N/A	
6	Compression bandage	Bandage, cohesive 7.5 m x 4.5 cm 1 x roll Coban	N/A	
7	Sterile gauze	Gauze swabs 100 x 100 mm (1-ply) – **STERILIZED.**	N/A	Excess quantity for instances of excess bleeding, where the 20 swabs in the kit will not suffice.
8	Suture — braided/ absorbable	Suture 3/0 braided synthetic 75 cm, on reverse cutting needle 26 mm. (Example: vicryl, polysorb).	N/A	Excess quantity where more than 2 sutures are needed. This can be the case during training or if there is excessive bleeding.
9	Sterile surgical gloves	Range of sizes: 7, 7.5, 8, 8.5.	N/A	For clinicians whose hands do not fit the sizes provided in the kit and instances where an additional person needs gloves.

Module 1: Infection prevention and waste disposal

Needed for any site using disposable or reusable surgical instruments				
Item #	Name of item	Product specification	Quantity (per month for 8-bed site)	Remarks
1	Surgical mask	Face mask, 1-ply, disposable.	320	
2	Surgical cap	Surgical cap, disposable.	160	Cloth caps (reusable) could be considered, in which case 2 per provider would needed.
3	Biohazard trash bag, small	15-litre size.	800	Colour coding for biohazard varies by country.
4	Biohazard trash bag, large	50-litre size	400	Colour coding for biohazard varies by country.
6	Medical plastic bin, small	Plastic pedal bin, 15 litres.	10	Use with biohazard bag above.
7	Medical plastic bin, large	Plastic pedal bin, 50 litres.	10	Use with biohazard bag above.
8	Buckets for instrument disinfection and soaking	10-litre size.	20	
9	Instrument brush	Instrument brush, 360 mm and bristles of 120 x 50 mm.	10	
10	Surgeon's nail scrub brush		10	
11	Protective eyewear	Protective eyewear (goggles).	20	
12	Utility gloves	Utility gloves, medium.	10	
13	Surgical scrub for providers	Chlorhexidine 4% solution.	50	
14	Sharp boxes	Capacity approximately 3 gallons but could vary by volume of MCs at the site.	16/week	for low-resource and mobile settings, consider using cardboard version.
15	Alcohol hand washes for providers	Contain isopropanol, ethanol, n-propanol or a combination of these ingredients.	25 litres	
16	Soap for scrubbing instruments	Best if contains enzymes that dissolve proteinaceous material.	25 litres	
17	Bleach for soaking instruments	3.5% sodium hypochlorite.	50 litres	

Module 2: Equipment for male circumcision sites

Needed for any site using disposable or re-usable surgical instruments				
Item #	Name of item	Product specification	Quantity (for 8-bed site)	Remarks
1	Operating stool	Operating stools, adjustable height.	8	Optional, depends on surgeon's preference for standing or sitting.
2	Operating table	Table, examination, folding, 2-section with washable pad, minimum height of 68 cm.	8	
3	Standing lamp	Standing one-bulb spotlight/lamp with adjustable arm.	8	
4	Autoclave	Autoclave, size depending on size of site.	1	Optional for programmes that use all disposable instruments.
5	Step ladder	Step ladder, 1 step, anti-slip rubber, chrome-plated steel, plastic-covered feet.	8	Optional.
6	Intravenous stand	Intravenous stand, 2 hooks, on 5 castors, adjustable from 115 to 210 cm.	1	Optional.
7	Wheelchair	Wheelchair with removable arms and footrests.	1	Optional.
8	Recovery bed	Recovery bed with mattress.	2	
9	Recovery chair	Recovery chairs.	4	
10	Patient trolley	Patient trolley with side rails and washable pad, estimated dimensions 183 x 69 x 87 cm.	1	Substitute spine board if mobile unit or static MC unit in rural area.
11	Instrument stand	Mayo stand (extends over the patient).	8	
12	Diathermy machine	Diathermy machine, monopolar (can be dual monopolar/bipolar if this does not increase cost).	8	
13	Diathermy plate	Diathermy (AKA cautery, electro surgery) plates (AKA 'patient return electrodes' or 'grounding pads').		In the US, these are almost always disposable adhesive pads. However, metal plates are available internationally for the same purpose and are reusable. Best to get a machine that uses a plate that does NOT require the addition of a gel or a wet cloth in order to be effective. Example: Sutron 80 diathermy plates can be used without water or gel.
14	Diathermy pencil	Diathermy (electrocautery) pencil (wand).		This also includes the tip (which is part of the consumable package).

Module 3: Male circumcision emergency medical supplies

Needed for any site using disposable or reusable surgical instruments				
Item #	Name of item	Product specification	Quantity	Remarks
1	Emergency trolly	Cart with labelled drawers, including mechanism for plastic tab 'locks'.	1	For mobile male circumcision units, this will need to be in a portable 'jump bag'. Picture provided of both options.
2	Adrenaline	Adrenaline 1mg/ml, 1ml.	Box of 10 ampules	
3	Atropine	Atropine 500 mcg/ml.	Box of 10 ampules	
4	Glucuse	Glucose 50%.	50ml/bottle	
5	Sodium chloride	Sodium chloride 0.9% IV solution: 1-litre bottle or bag.	5	
6	Non-rebreather oxygen mask and oxygen tubing	Non-rebreather oxygen mask and oxygen tubing.	1	
7	Ambu bag	Ambu bag: adult-size face mask with reservoir bag and oxygen tubing.	1	
8	Pen torch	Pen torch, battery-operated.	1	
9	Oropharyngeal airway	Oropharyngeal airway, transparent, size 3 (96 mm)	1	Also known as guedel airways or OPAs.
10	Oropharyngeal airway	Oropharyngeal airway, transparent, size 4 (103 mm).	1	
11	Oropharyngeal airway	Oropharyngeal airway, transparent, size 5 (120 mm).	1	
12	Glucometer	Glucometer.	1	
13	Glucometer strips	Glucometer strips.	10	
14	Sphygmomanometer	Sphygmomanometer, aneroid, 300 mm Hg, with adult cuff (for arm diameter approximately 9–14 inches).	1	
15	Stethoscope, binaural	Stethoscope, binaural, standard, dual head.	1	
16	Tourniquet	Small elastic tourniquet/band, 90 x 5 cm.	1	To compress arm for I.V. access.
17	Laryngoscope	Laryngoscope, battery-operated, with three blades (#1, #2, #3), either Miller or MacIntosh.	1	
18	I.V. infusion tubing	I.V. administration tubing (connects bottle or bag of fluid with canula in patient's vein). At least one injection port required through which to give drugs.	2	
19	I.V. catheter	I.V. catheter: 18 G x 1.75 inch (1.3 x 45 mm) with port & wings, sterile, disposable.	5	
20	I.V. catheter	I.V. catheter: 22 G x 1 inch (0.9 x 25 mm) with port & wings, sterile, disposable.	5	
21	I.V. catheter	I.V. catheter: 16 G x 1 inch (0.9 x 25 mm) with port & wings, sterile, disposable.	2	
22	Tape	Tape: to secure I.V. catheters and ET tubes.	1 roll	
23	Pump, aspirating, surgical	Pump, aspirating, surgical, portable, foot-operated, capacity up to 600 mm Hg.	1	

24	Endotracheal tube	Endotracheal tube, CH 6, 50 cm, disposable, sterile.	1	
25	Endotracheal tube	Endotracheal tube, CH 7, 50 cm, disposable, sterile.	1	
26	Endotracheal tube	Endotracheal tube, CH 8, 50 cm, disposable, sterile.	1	
27	Oxygen cylinder	Oygen cylinder: 10-litre, with regulator.	1	Regulator and tank shown separately.
28	Disposable exam gloves	Disposable exam gloves, medium size.	1 box	
29	Alcohol swabs	Alcohol swabs, individually packed.	10	
30	Gauze	4 x 4 inch (or 10 x 10 cm) in packages of 2.	5	
31	Syringe 2 cc	Syringe 2 cc.	5	
32	Syringe 10 cc	Syringe 10 cc.	5	
33	Needle 23 gauge	Needle 23 gauge.	5	
34	Needle 21 gauge	Needle 21 gauge	5	
35	Pulse oximter	Battery-operated, fingertip pulse oximeter.	1	
36	Emergency protocols	Laminated protocols for basic resuscitation in anaphylaxis.	1	

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